Second Workshop on Tracking, Telemetry, and Command Systems for Space Applications

KEY SYSTEM ARCHITECTURE ISSUES CONCERNING SPACE LINK EXTENSION (SLE) SERVICES

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During the design and implementation of the CCSDS Space Link Extension (SLE) services for the INTEGRAL mission, a few key system architecture issues were identified. While these issues are addressed in the context of the Deep Space Mission System (DSMS), as the service provider, and the INTEGRAL Mission Operations Center (MOC), the service user, they do have important ramifications to the design of any service-oriented systems. From a system engineering perspective, the following issues with their respective design considerations discussed in this paper could serve as a useful guidance to any future implementation of the SLE services:

1. Access point of the SLE service provision - Where in the service providing system is the point of service interface? The tracking station or the control center?
2. Dependency of the SLE services on the service management - What are the interactions required between the SLE service user, transfer service provider, and service management? What are the monitor and control capabilities allocated to the transfer services and service management, respectively?
3. Common SLE Application Programming Interface (API) - What are the design principles applied to the Common SLE API? What is its benefit to the interoperability?
4. Interface between the SLE service layer and transport layer - To the SLE service layer, what is the interface with the underlying communications protocols? What are the options of the underlying communications protocols and the middleware technology?
5. Complexity of the "service provider - service user" interface due to different security domains - What are the effects of security measures on the interface between the service provider and service user systems? What are the design considerations in ensuring the two different security domains operate together?
6. Value of the offline service delivery mode - How does the offline service delivery mode differ from the query-oriented transaction? What are the value-added purposes of the offline service delivery mode?
7. Amplified need for the SLE forward packet service - What does the service user lose in relying solely on the CLTU radiation service from service provider? Are there any differences in performance to the service user

between the SLE forward packet service provided at the tracking station and COP with loop closure executed at the mission operations center?

8. Amplified need for the SLE tracking data services - Why do we need the SLE tracking data services? What does the introduction of tracking data service mean to the service system architecture?
9. Standardization of the initial acquisition procedures - What is the importance of standardizing the initial acquisition procedures and including them as part of the SLE services?
10. Need for persistent service performance accountability - How is the service performance accountability reported in the current SLE protocol? What are its pitfalls?
11. Recovery from the underlying communications anomaly - How does the SLE service layer recover from the anomalies occurring in the underlying communications layer? What are the deficiencies in our implementation of such recovery capability?
12. Integration of the SLE service-level interface into operational interactions - From operational interface perspective, i.e., team-to-team interactions, how do we melt in the SLE service interface into the operational procedures in the most effective manner?
13. Testability of SLE services - Should the SLE protocol be augmented with certain automated "built-in-test" capabilities?

Both JPL and ESOC intend to move their systems to a service paradigm that is fully CCSDS SLE-compliant. We expect to have our systems infused with new capabilities taking advantage not only the service interface protocol but also the principle of the service paradigm.